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State of California
Department of Public Works
Division of Highways
Materials and Research Department

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Our No. 62286-S

Mr. E. W. Hampton
Acting State Architect
Division of Architecture
Sacramento, California

Attention: Mr. Preston Roche, Supv. Mech. Engr.

Dear Sir:

Submitted in accordance with your letter of August 14, 1962, is a report of:

FRESNO STATE COLLEGE

SPEECH DRAMA AUDITORIUM

NOISE REDUCTION SURVEY

Study by . . . . . Structural Materials Section
Under general direction of . . . . . E. F. Nordlin
Tests and report by . . . . . Louis Bourget

Very truly yours,

F. N. Hveem
Materials and Research Engineer

LB:mw

INTRODUCTION

Initial tests were made in the auditorium in September 1962 with the assistance of Mr. Vern Thornburg of the Division of Architecture and members of the Fresno State College maintenance staff. The major sources of trouble were identified at this time, but a later series of tests were required to determine the probable effectiveness of the corrective measures proposed in this report. These later tests were performed in December 1962 and are presented in octave-band series, on charts with NC curves, as preferred by the American Society of Heating and Ventilating Engineers.

SUMMARY

A series of dynamic noise tests were performed to simulate the approximate noise reduction that may be expected if the remedial suggestions are adopted.

They indicate:

Noise reduction of about 13 decibels in the 4th octave-band, 300/600 cycles per second (cps).

Noise reduction of about 14 decibels in the 5th octave-band, 600/1200 cps.

Noise reduction of about 9 decibels in the 6th octave-band, 1200/2400 cps.

Noise reduction of about 5 decibels in the 7th octave-band, 2400/4800 cps.

These figures are most encouraging because the octave bands cited are very important to speech intelligibility. Therefore, noise reductions of the above order will contribute greatly to improved speech clarity and understanding.

REMEDIAL SUGGESTIONS

1. The three air vents located in the roof, directly over the stage, should be equipped with sound traps to reduce the penetration of aircraft noise.

2. (A) The vertical return air shaft (which runs from under the auditorium floor to Fan and Mechanical Room 206) should have an acoustical pad installed in the manner of a slow spiral, with a 180 degree turn from top (just below fan opening) to bottom (just above the port opening below the auditorium floor). The pad should begin diagonally across the longest horizontal dimension of the shaft (corner to corner) and be securely attached to the walls as it descends.

   (B) A 10 foot long solid barrier should be placed 3 feet away from the lower port opening, between auditorium floor and the concrete slab. The barrier surface facing the port, and the adjacent wall surfaces, should be covered with a one inch thickness of glass fiber duct-liner or an equally absorbent acoustical material of your choice. Please refer to Figure #1.

3. The return air fan E-1 should be equipped with spring type vibration isolating mounts. The present rubber mounts are not adequate to prevent noise conduction.

4. The doors between Mechanical Room 7 and Storage Area 6 (H-1 of 11) are equipped with ventilating louvres. If such ventilation is required, it should preferably be obtained through a sound trap type of ventilator mounted through the wall. The doors should be as acoustically opaque as possible. Installation of a sound trap vent will permit the door louvres to be completely sealed with a metal cover and a gasket or mastic seal around the edge for an air-tight fit.

5. The two vertical pipes, near the roll-up stage door 17/M, pass through Scene Shop 115 on their way to the cooling tower on the roof. These should probably be wrapped as there is some noise present whenever the water is flowing.

This concludes our remedial suggestions. Some comment on their order of presentation seems fitting.

Suggestion #1 is the most important whenever aircraft are overhead. At other times it is relatively unimportant.

Suggestions #2 (A) and (B) are of prime importance.

Suggestion #3 completes the job of 2 (A) and (B).

Suggestion #4 is highly desirable.

Suggestion #5 is desirable but not vital.

TESTS AND COMMENTS

The principal internal noise source was determined to be from exhaust fan E-1. Figure 2 is an octave band portrayal of total equipment noise on an NC chart.

Figure 3 shows a marked noise reduction in the speech interference range, octaves 4, 5, and 6, achieved by temporarily plugging the return air port with a heavy plywood cover. This is a reasonable approximation of what can be accomplished by absorptive treatment in the shaft plus the acoustic barrier already described.

Figure 4 illustrates an additional improvement in the speech interference range, by turning off fan E-1. This is a reasonable approximation of the additional improvement that can be realized if the present rubber mountings on fan E-1 are changed to a more effective spring suspension type, providing the air shaft treatment and acoustic barrier are first installed.

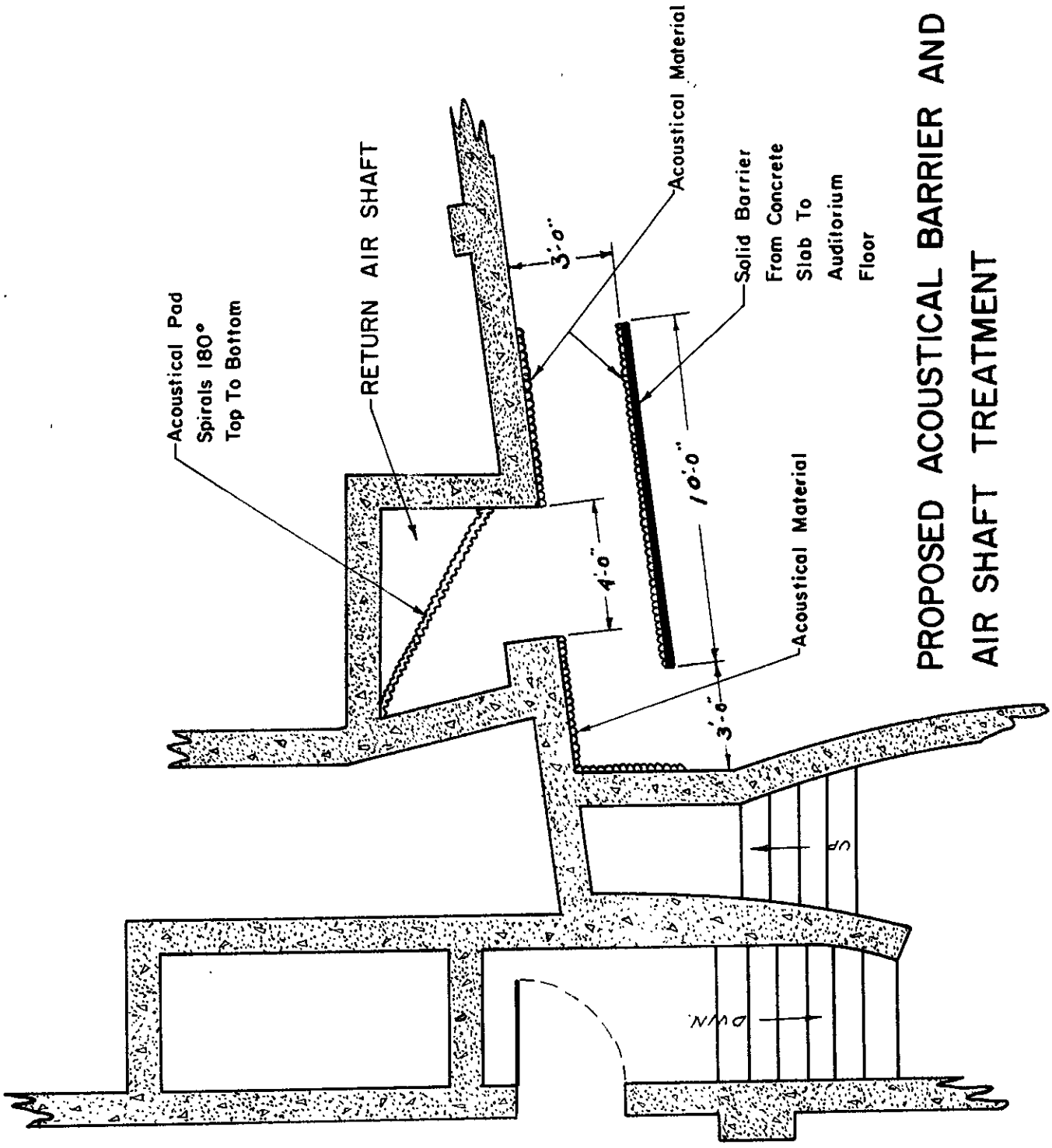
These dynamically simulated corrective tests resulted in a marked degree of noise reduction that seemed acceptable to several members of the school staff who acted as observers.

In conclusion, it is recognized that low frequency noise in octave bands 1, 2, and 3 was unaffected. While a reduction might be desirable, it is regarded as economically impractical with the mechanical equipment located, as it is, within the building and adjacent to the auditorium. The significant noise reduction that can be achieved in the very important speech interference range is fortunately more noticeable and feasible.

Technical note:

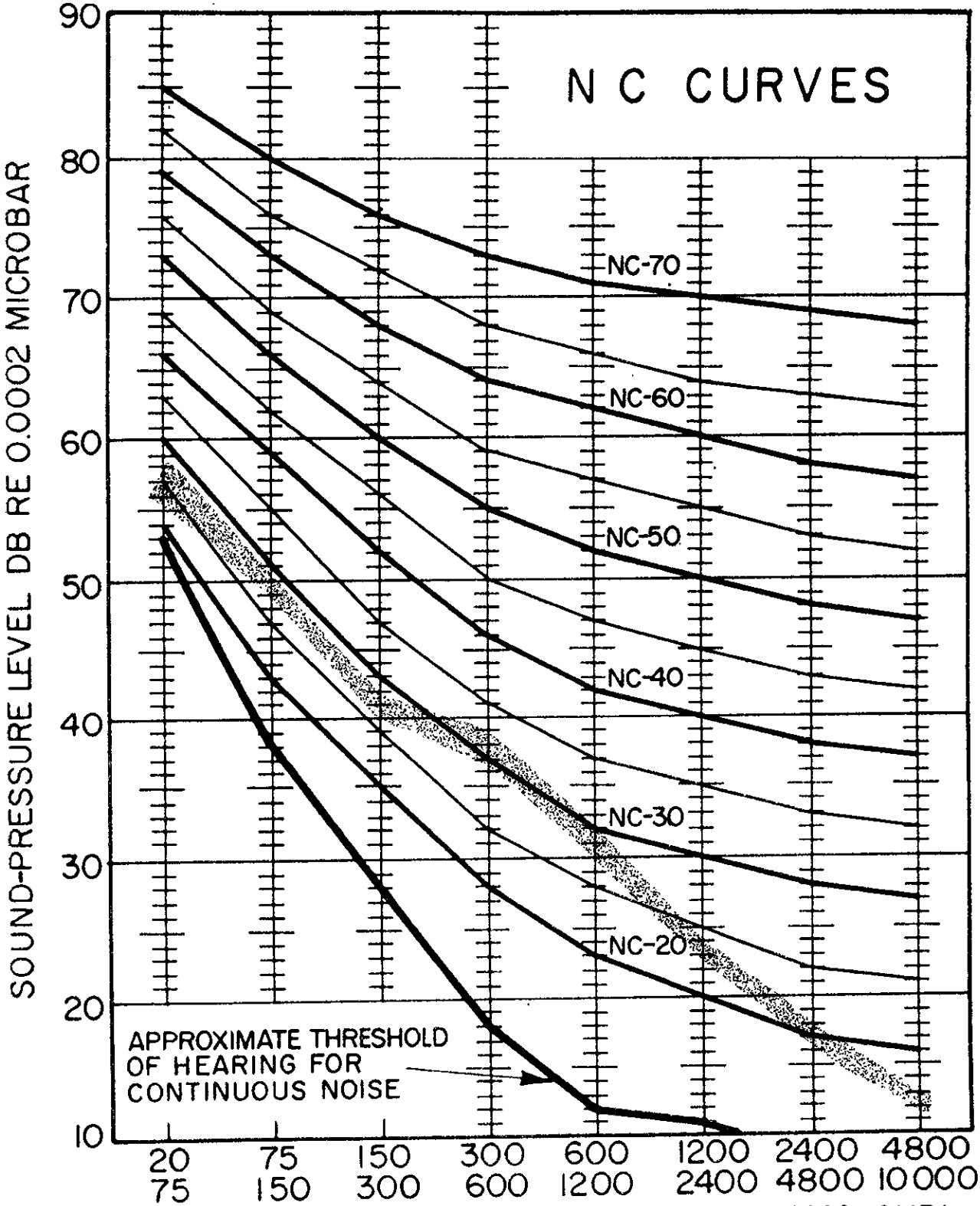
An acoustical pad, suitable for the described installation in the return air shaft, can be made from a one inch thickness of duct-liner placed between outer covers of asbestos cloth, the whole to be quilted together and seamed at the edges to prevent ravelling. Care will be required so as not to tear the cover during installation.

Figure 1



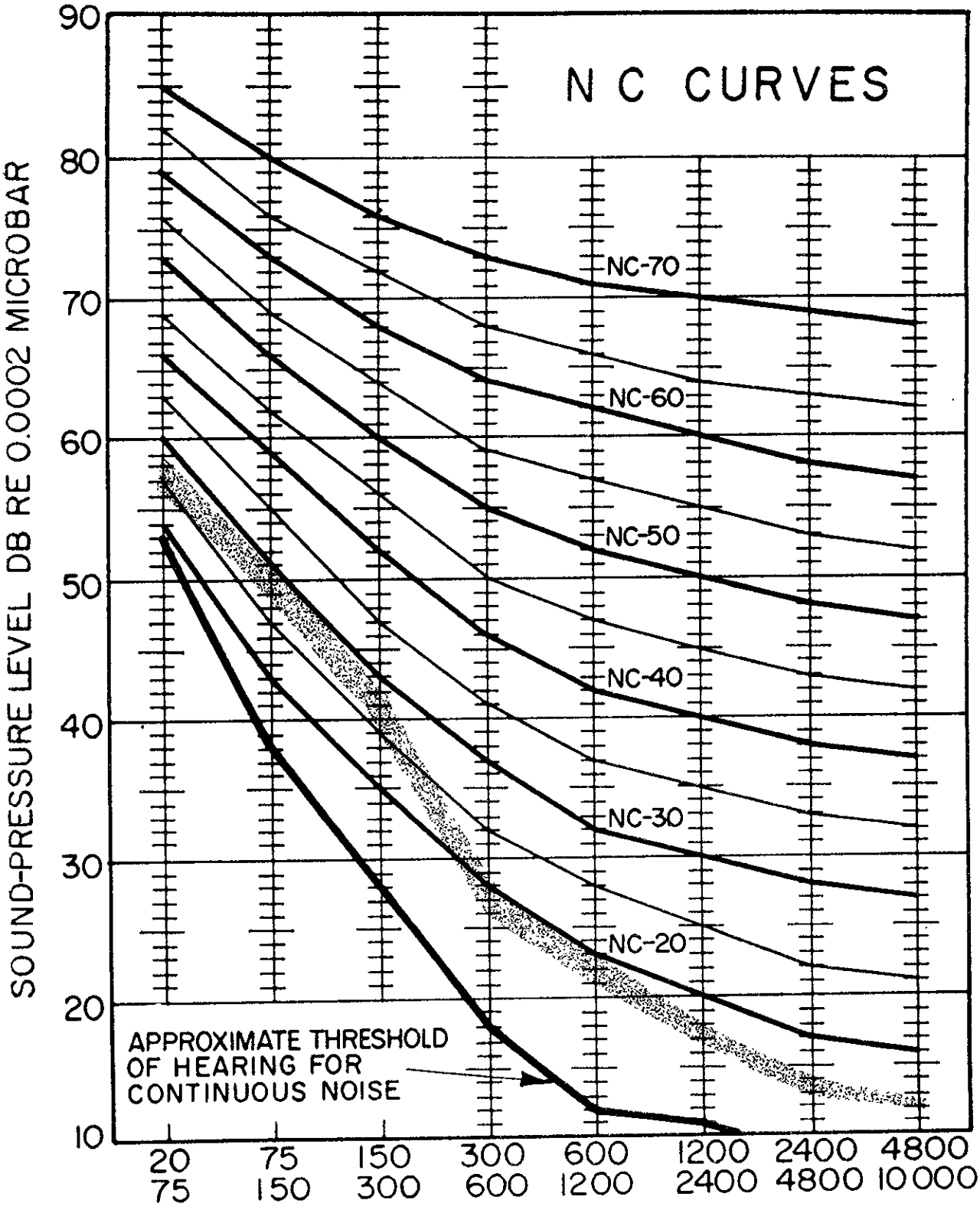
(Portion of basement plan taken from sheet 4 of file 8-K-27)

Figure 2



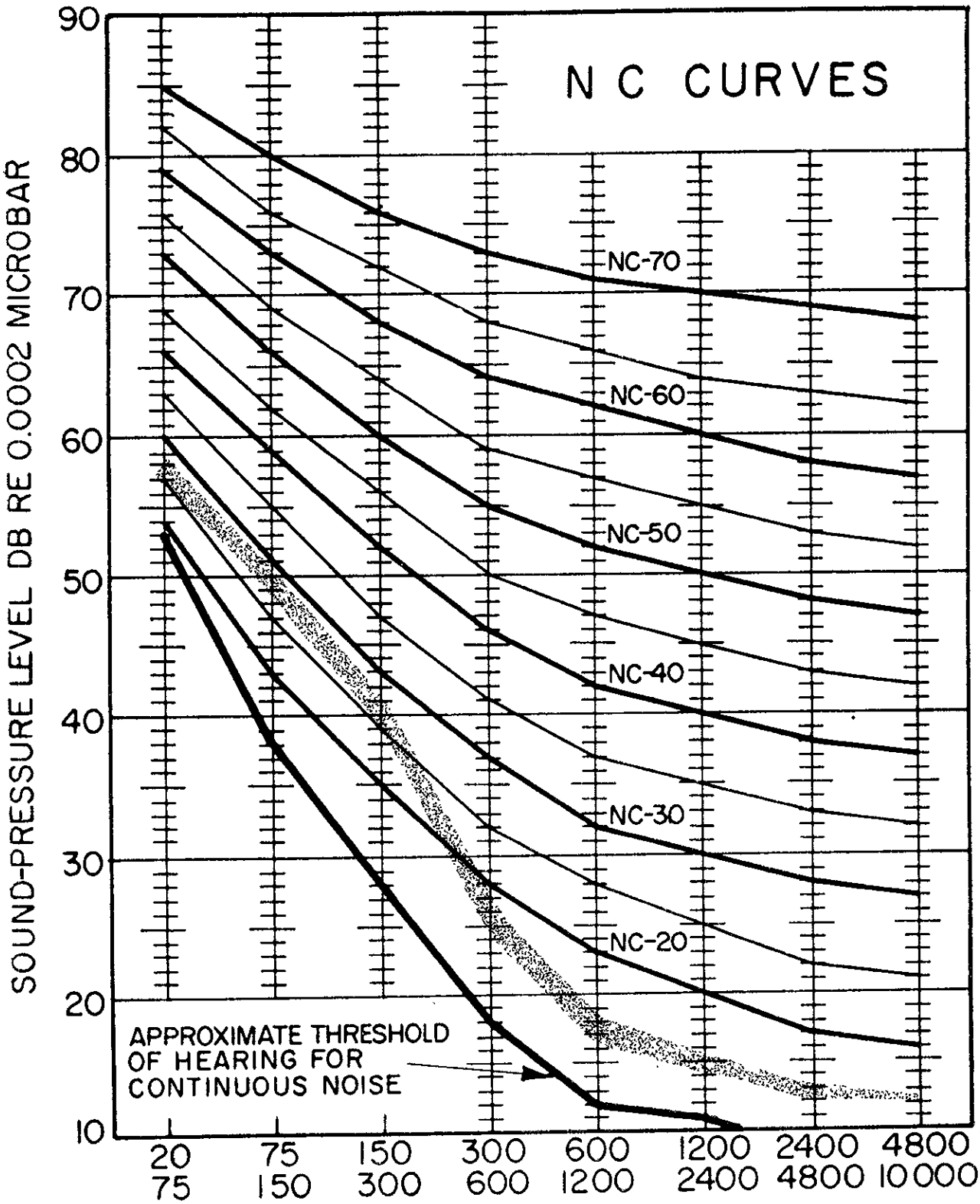
FRESNO STATE COLLEGE SPEECH DRAMA AUDITORIUM MEASUREMENTS FULLY DOWNSTAGE ON ORCHESTRA PIT COVER "ALL FANS ON"

Figure 3



SAME LOCATION AND CONDITIONS EXCEPT:
"RETURN AIR PORT PLUGGED"

Figure 4



SAME LOCATION AND CONDITIONS EXCEPT:
"EXHAUST FAN E-1 OFF AND RETURN PORT PLUGGED"